

Synchrotron Based IR Microspectroscopy of Thermal Degradation Mechanisms in Polymer Composite Systems	U2B
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The enhanced sensitivity of an infrared microscope integrated with a synchrotron light source was used to characterize the time dependent thermal degradation in several polymer matrix composite systems. For graphite fiber/ polyimide composites, the increased spatial resolution provided by the microscope allows IR characterization of the inter-fiber polymer matrix component of the samples without the spectral distortion effects contributed by the broad band absorbance of the graphite fibers. This advantage allows for unambiguous determination of local variations in chemical structure in the composite materials such as in the surface and interior regions of samples exposed to thermo-oxidative environments as well as identifying preferential attack between interply and intraply regions.

In this study the FTIR microscope was used to chemically quantify the effectiveness of different fiber sizing pretreatments on composite thermo-oxidative durability. A series of unidirectional, graphite fiber (Amoco T650-75) / PMR-II-50 polyimide composite samples were prepared with different reactive coupling based fiber sizing pretreatments. The samples were heat treated at 370C for up to 700 hrs in air. Polished cross-sections were prepared of samples aged at specific time intervals and IR microreflectance measurements taken from select matrix rich regions at the surface, center and interply areas of the specimens. The IR spectral features associated with the time dependent, diffusion limited, thermo-oxidative degradation of the matrix phase were analyzed through the thickness of the composite. Specific fiber sizings formulations were identified which significantly reduced the degree of matrix degradation in the subsurface regions of the composite specimens. Synchrotron IR microspectroscopy is demonstrated as a powerful technique for determining local variations in chemical structure in polymer composite materials and for identifying degradation mechanisms in these materials and the kinetics of these mechanisms under specific exposure conditions.